E-4. Airports

This chapter is a joint effort by the NC Airports Association (NCAA), the NC Department of Transportation Division of Aviation (NCDOA), NC State University (NCSU), W.K. Dickson and Company, and the NC Department of Environmental Quality (NCDEQ). The information presented here is based on site visits and studies made of numerous airports as shown in Figure 1.

Figure 1: Airports Visited or Studied to Create this Chapter

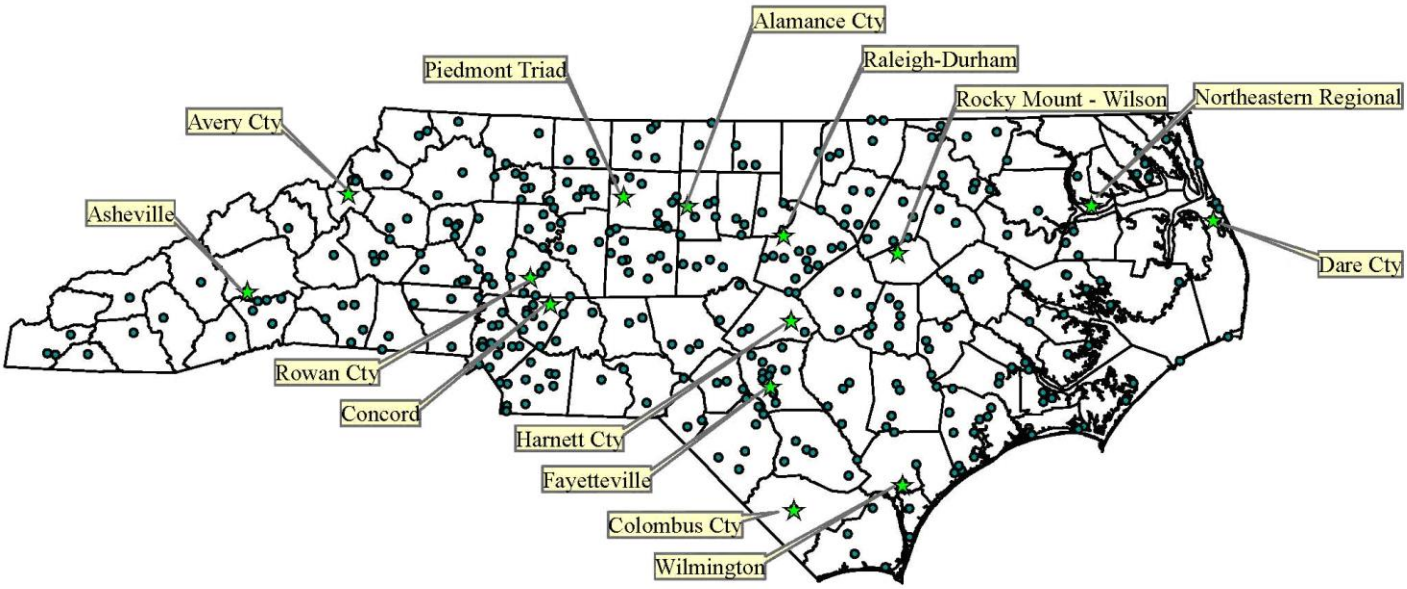


Table of Contents

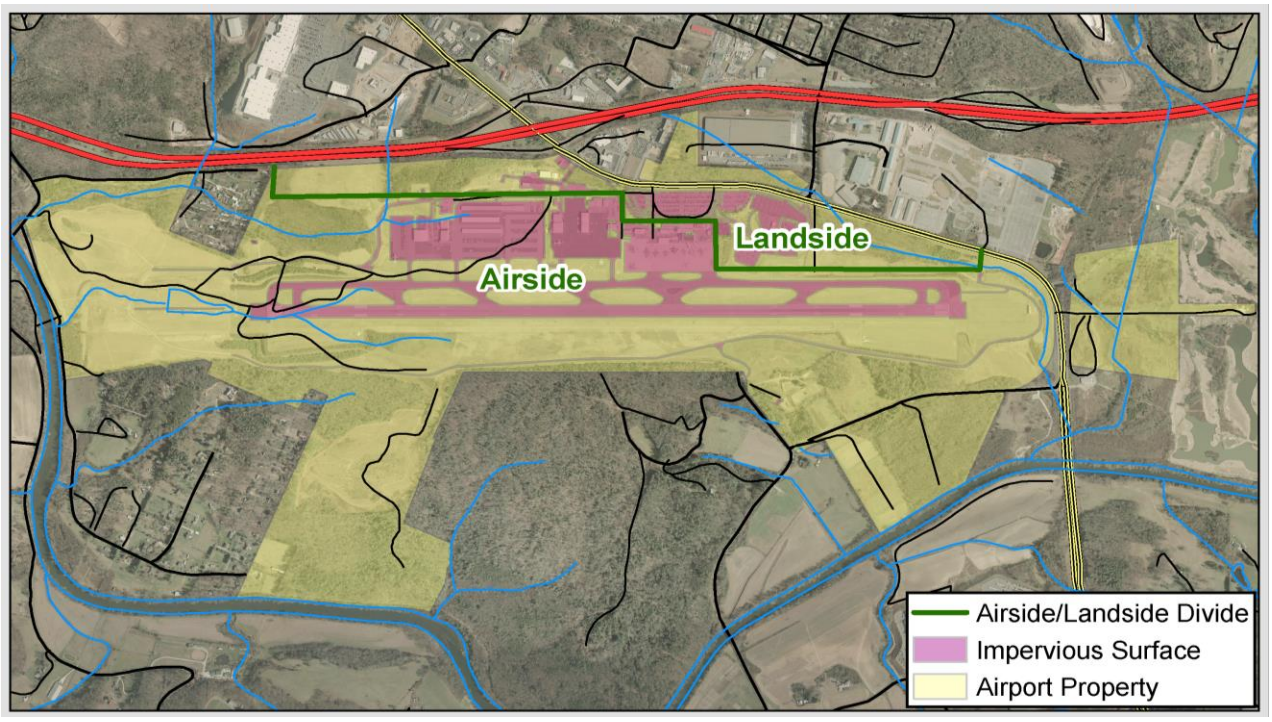
What makes airports unique?

Airport projects differ from typical development projects in North Carolina in a number of ways:

- The vast majority of airport projects are expansions of existing facilities. These expansions include the addition of new hangars, terminal building, runway extensions, and new taxiways, apron and ramp areas.
- Airport facilities are surrounded by a large amount of open space; the overall airport property typically has a low percentage of BUA.
- Runoff from airport runways typically has very low concentrations of TSS, nutrients and other pollutants.
- Flight safety requires that standing water (including detention-based SCMs) be strictly avoided on and around airport facilities.
- NC General Statutes dictate that post-construction stormwater from airport facilities be regulated differently from typical development projects.

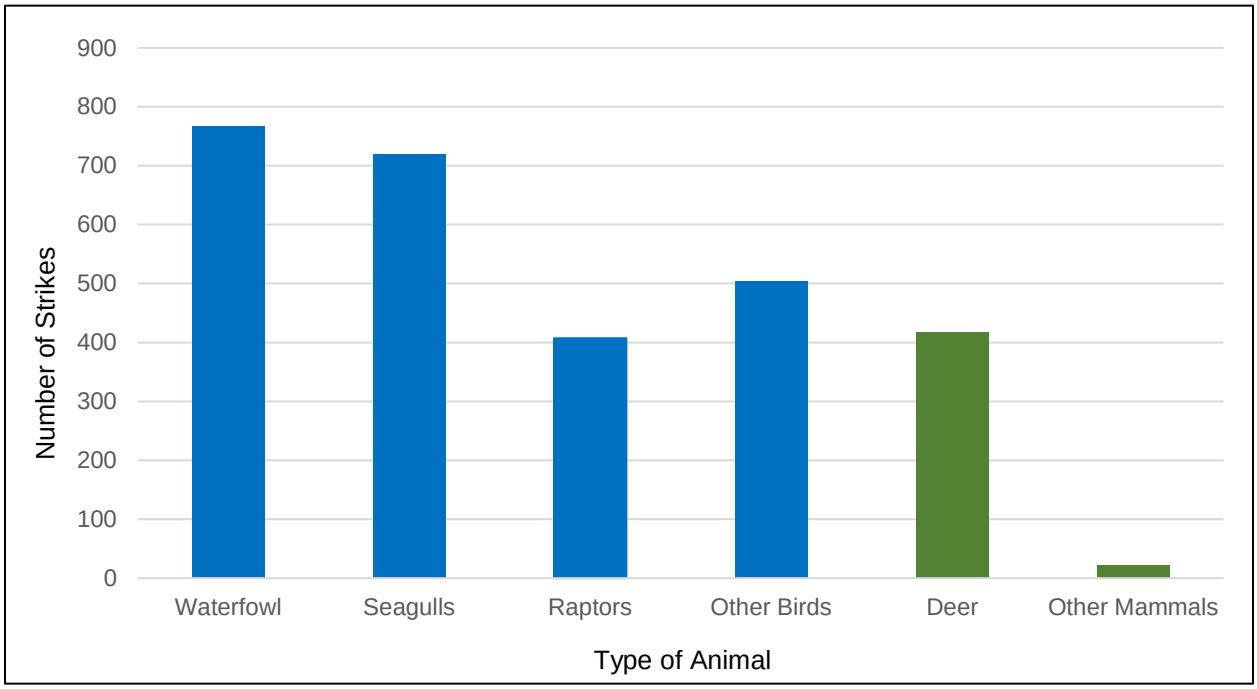
Figure 2 illustrates the low percentage of BUA on a typical airport property. Airside refers to all areas where aircraft are operated or serviced. This area includes runways, taxiways, hangars, ramps, and aprons. Landside refers to all other areas. WK Dickson has calculated that BUA on airport properties to typically ranges between 8 and 24 percent. Many impervious areas on airports, namely runways and taxiways, are disconnected. Often with less than 100 feet of flow on a paved surface, stormwater runoff enters grassed areas with widths often measuring greater than 60 feet. However, other locations on airport grounds, such as the hangar area and parking lots often have a direct discharge to either ditches or a stormwater conveyance system.

Figure 2: Typical Airport Property



As Figure 3 shows, wildlife strikes, particularly those involving birds, damage numerous US aircraft. To enhance flight safety, to select practices that do not provide habitat or food for birds or other animals. Wet ponds and stormwater wetlands should not be used near airport facilities. In addition, vegetation with berries, nuts, seeds, flowers, or edible roots should be avoided.

Figure 3: Animal Strikes Causing Damage to US Aircraft from 1990-2005 (FAA, 2010)



Relevant Regulations

These are the regulations that are most relevant to airports, they will be re-iterated below as appropriate:

- N.C.G.S.143-214.7 (c3) prohibits DEQ from requiring airports, as well as other development projects located within five miles from the airport air operations area, to use SCMs that promote standing water.
- N.C.G.S. 143-214.7(c4) states that airport projects are deemed permitted if "overland stormwater flow" is provided. Deemed permitted facilities are not required to obtain stormwater permits from DEQ.
- 15A NCAC 02H .1001(1)(e) exempts deemed permitted facilities from the requirements of the post-construction state stormwater program.
- Many airports will also be subject to NPDES industrial stormwater permitting program, the general NPDES stormwater permit for construction activities, and the EPA's Oil Spills Prevention and Preparedness Regulations.

Deemed Permitted Airport Projects

N.C.G.S. 143-214.7 (c4) [Deemed Permitted Airport Facilities]
"The Department shall deem runways, taxiways, and any other areas that provide for overland stormwater flow that promote infiltration and treatment of stormwater into grassed buffers, shoulders, and grass swales permitted pursuant to the State post-construction stormwater requirements."

"Deemed permitted" means that as long as an airport project follows the appropriate requirements in the NC General Statute, then no review or permit shall be required by the NCDEQ post-construction stormwater program.

Although the general statute does not define "overland stormwater flow." The airport industry has worked with NCDEQ and agreed that "overland stormwater flow" shall be considered to be met when the provisions of 15A NCAC 02H .1060 [Disconnected Impervious Surfaces] are followed.

The philosophy behind Disconnected Impervious Surfaces (DIS) is that a significant reduction in runoff volume and a corresponding reduction in pollutant loading can be achieved simply by allowing runoff from BUA to drain into uniform, gently sloped grassed areas. Airport runways, taxiways and other facilities are typically surrounded by grassed areas that meet this description. See Figure 4.

Figure 4: Vegetated Receiving Areas at Airports in North Carolina

Chapter C-10, Disconnected Impervious Surfaces, details the requirements for designing, constructing and maintaining DIS areas. For convenience, the three Minimum Design Criteria for DIS are repeated below:

DIS MDC 1. VEGETATED RECEIVING AREA FOR DISCONNECTED ROOFS.
The following requirements shall apply to vegetated receiving areas for disconnected roofs:

(a) a maximum of 500 square feet of roof shall drain to each disconnected downspout;
(b) the receiving vegetated area shall be a rectangular shape. The length of the rectangle in the direction of flow shall be a minimum of 0.04 times the area of the roof that drains to it. The width of the rectangle shall be one-half the length of the rectangle.
(c) the downspout shall discharge in the center of upslope end of the vegetated receiving area;
(d) the downspout shall be equipped with a splash pad; and
(e) the vegetated receiving area shall not include any built-upon area.

DIS MDC 2. VEGETATED RECEVING AREA FOR DISCONNECTED PAVEMENT.
The following requirements shall apply to the vegetated receiving area for disconnected pavement:

(a) the pavement draining to the vegetated receiving area shall be a maximum of 100 feet in length in the direction of flow;
(b) the vegetated receiving area shall be a minimum of 10 feet in length in the direction of flow; and
(c) the vegetated receiving area shall not contain any built-upon area except for incidental areas such as utility boxes, signs, and lamp posts.

DIS MDC 3. VEGETATED RECEIVING AREA SPECIFICATIONS.
The following specifications shall apply to the vegetated receiving areas for both disconnected roofs and disconnected pavement:

(a) vegetated receiving areas shall have a uniform transverse slope of 8 percent or less, except in Hydrologic Soil Group A soils where slope shall be 15 percent or less;
(b) the pH, compaction, and other attributes of the first eight inches of the soil shall be adjusted if necessary to promote plant establishment and growth;
(c) the vegetated receiving area shall be planted with a non-clumping, deep-rooted grass species; and
(d) soils shall be stabilized with temporary means such as straw or matting until the permanent vegetative cover has taken root or the runoff shall be directed elsewhere until vegetation has established.

A quick summary of what this means for runways and taxiways: To be deemed permitted, a maximum width of 100 feet of pavement shall drain to a minimum width of 10 feet of vegetated receiving area. The maximum slope of the pavement shall be eight percent for most soils and the other vegetated receiving area specifications associated with DIS MDC 3 shall be met.

Airport Projects that Require a Stormwater Permit

Airport projects that do not meet the MDC associated with DIS shall require a post-construction stormwater permit. The permit will required stormwater from the project shall be treated in a stormwater control measure (SCM). Per the general statutes, NCDEQ shall not require the use of SCM that pond water at an airport facility for the crucial safety reasons that are discussed above.

N.C.G.S. 143-214.7 (c3) [Use SCMs that do not Pond Water]
" . . . the Department shall not require the use of stormwater retention ponds, stormwater detention ponds, or any other stormwater control measure that promotes standing water in order to comply with this section at public airports that support commercial air carriers or general aviation services. . ."

The stormwater control measures that pond water for more than 12 hours are wet ponds, stormwater wetlands, infiltration systems, and dry ponds (see Figure 5). If a dry pond is to be used on an airport, then it may be designed to draw down in 40 hours rather than the 48-hour minimum required per the dry pond MDC. See Figure 5.

Figure 5: SCMs that Pond Water:
Wet Pond (upper left), Stormwater Wetland (upper right),
Infiltration Basin (lower left), and Dry Pond (lower right)

Table 1: SCMs that do not Pond Water with Suggestions for Airport Application

SCM with link to chapter of manual	Suggestions for Application at an Airport
Bioretention cell	A bioretention cell ponds water for less than 12 hours If it is maintained in accordance with the bioretention MDC. When using bioretention on the airside, vegetation should *always* be grass to eliminate the risk of mulch being sucked into an engine. Other benefits of grassed cells include: views free of obstruction for the pilots, and reduced wildlife habitat. On the landside, a shrub-mulch system is permissible, though trees should be avoided.
Infiltration trench	An infiltration basin ponds stormwater for up to 72 hours so it is not advisable for use on an airport. However, an infiltration trench retains stormwater in aggregate below the ground surface and therefore does not pose a safety issue. Infiltration trenches transfer more stormwater to the soil than any other type of SCM, and they more closely mimic the natural hydrology. These systems could be sited parallel to runways or taxiways, outside the limits of RSA.
Sand filter	Sand filters are a comparatively expensive practice, and do not mitigate the peak flow from a storm event. However, sand filters do remove TSS, nutrients, and heavy metals from stormwater.
RWH	Rainwater harvesting systems (RWH) be used for any roof, such as a hangar or a terminal building. RWH requires a reliable water use to provide a benefit. Suggested uses on airports include landscape irrigation near a terminal building, washing hangars, flushing commodes, and washing airplanes and cars. Land application of the harvested water should be avoided near runways and taxiways; saturated soils force earthworms and grubs to the surface, which attracts birds.
Permeable pavement	Permeable pavement can be used to treat parking lots and other paved surfaces. Permeable pavement does require maintenance; therefore, it is best implemented in areas that receive relatively infrequent traffic, such as public airport terminal parking lots, rental car lots, Fixed Base Operators (FBOs), and employee parking lots (all of which are landside). Permeable pavement should not be used on the airside because of FOD concerns. Also, permeable pavement may not be used in areas where toxic materials are stored or handled.
Treatment swale	A treatment swale is a secondary SCM; however, it may be used on an airport where a primary SCM is not feasible (note a swale is not an acceptable primary SCM on other projects within the five-mile radius). Treatment swales have trapezoidal cross-sections and are designed to minimize the depth and velocity of stormwater flow for maximum contact time with the grass and possibly some infiltration.
Dry pond	Dry ponds do pond water for more than 12 hours after storm events but still may be desired to treat a large drainage area. On an airport, the required draw time may be reduced to as little as 40 hours (from the 48 hours required by the MDC) to address flight safety. Additionally, airports may eliminate the small permanent pool near the outlet structure, use steeper side slopes to reduce wildlife attraction, and use pre-treatment other than a forebay. Maintenance is a crucial issue at airports because clogged dry pond outlet structure can lead to ponding of water, the creation of wetland conditions, and habitat for wildlife.

Stormwater Master Plan

A Stormwater Master Plan approach takes into account the stormwater challenges and needs across the entire airport property, and provides a comprehensive plan to address all the issues concurrently. For example, instead of obtaining separate permits for several individual stormwater projects, using the master plan approach, several stormwater projects could be designed to work in concert as one larger project, thereby increasing the likelihood that the projects will be effective, and limiting the number of permits required.

The Five-Mile Radius

N.C.G.S. 143-214.7 (c3) [The Five Mile Radius]
" . . . Development projects located within five statute miles from the farthest edge of an airport air operations area . . . shall not be required to use stormwater retention ponds, stormwater detention ponds, or any other stormwater control measure that promotes standing water in order to comply with this section. Existing stormwater retention ponds, stormwater detention ponds, or any other stormwater control measure that promotes standing water in order to comply with this section located at public airports or that are within five statute miles from the farthest edge of an airport operations area may be replaced with alternative measures included in the Division of Water Resources' Best Management Practice Manual chapter on airports. In order to be approved by the Department, alternative measures or management designs that are not expressly included in the Division of Water Resources' Best Management Practice Manual shall provide for equal or better stormwater control based on the pre- and post-development hydrograph. Any replacement of existing stormwater retention ponds, stormwater detention ponds, or any other stormwater control measure that promotes standing water shall be considered a minor modification to the State general stormwater permit."

As the statute indicates, any new projects that will be located within a five-mile radius of airports shall not be required to use SCMs that pond stormwater; they shall have the same options as indicated in Table 1 above. In addition, any existing facilities that wish to convert their "wet" SCMs to SCMs that do not pond water shall be able to update their permits without paying a stormwater permit fee to the State.

Recommendations

RECOMMENDATION 1: PROPERTY MAINTENANCE.
Maintenance around the airport property should be tailored to reduce the flight safety risk from wildlife.

Some suggestions from DEQ include selecting vegetation species that do not attract birds or mammals, maintaining a 10 to 12-foot-tall perimeter fence to discourage deer and other mammals, installing exclusion devices for birds on hangars and towers, and removing wooded areas within the perimeter fencing.

In addition, DEQ recommends avoiding mowing to prevent rutting, which can result in ponded water on the airport property.

Figure 6: Rutting Due to Mowing

RECOMMENDATION 2: POLLUTION PREVENTION
It is recommended that airports conduct frequent examinations of the airport property to identify and remedy potential sources of pollutants.

Pollutants of concern at airports include typical urban pollutants (nitrogen, phosphorus, sediment, hydrocarbons, and heavy metals) and airport-specific pollutants (de-icing fluid, urea, and aviation fuels such as avgas and jet fuel). Stormwater samples collected at the Wilmington Airport show that runoff from its runways and taxiways may be significantly cleaner than runoff from typical urban areas or roads and highways. This might be due to the regular cleaning of airport runways *(Stormwater Requirements for Airports Report for the NC Environmental Review Commission, Feb 2013)*.

Suggested methods for preventing pollution include:

- Conduct frequent inspections of SCMs.
- Revegetate areas of bare soil.
- Avoid using fertilizers, which contain high amounts of nitrogen and phosphorus, except as needed during vegetation establishment
- Perform vehicle maintenance activities under cover.
- Store chemicals in spill proof containers and/or inside.
- Post signage for hazardous materials.
- Educate airport staff about stormwater.
- Use designated snow removal and de-icing locations.

- Fix leaks promptly.
- Capture and treat de-icing fluids.
- Mow when grass is dry and vary the mowing pattern to avoid creating ruts which can act as a stormwater conveyance.

The vast majority of North Carolina's public general aviation (GA) airports do not use or store any aircraft or runway de-icing fluids, and instead opt to delay operations until temperatures warm sufficiently. Five North Carolina airports are referred to as "Part 139 Certified" (14 CFR Part 139). These are larger GA (non-commercial service) airports like Concord and Smith Reynolds. Some airports store urea onsite for runway de-icing (nutrient loading) and some aircraft owners /tenants at these airports do individual light spraying of wings.

North Carolina's nine Air Carrier (AC) airports include Raleigh-Durham, Charlotte, Greensboro, Pitt-Greenville, Fayetteville, Wilmington, Asheville, Onslow County (Albert J. Ellis), and Craven County (Coastal Carolina). Of these nine airports, Raleigh Durham, Charlotte, and Greensboro are already capturing and treating aircraft de-icing fluids (typically composed of ethylene glycol or propylene glycol). Of the remaining six, five are in eastern counties which use very small amounts of de-icing chemicals on aircraft, some years none at all.

RECOMMENDATION 3: SOIL AMENDMENTS
Consider soil amendments when soils at the airport property are not suitable for infiltration.

Where the soils are not suitable for infiltration the airport can amend the soils. However, in a Runway Safety Area (RSA), where soils must be compacted to ensure safety (FAA Specification P-152, FAA 2009), soil amendments may only be utilized in the uppermost four inches of the soil. Soil amendments may be used in conjunction with either vegetative filter strips, or grassed swales. Soil amendments typically increase infiltration rates by introducing coarse-grained, washed sand amendments into the in-situ soil. Soil amendments will improve infiltration by increasing soil pore space near the surface. Soil amendments are typically installed by tilling sand-size particles into the existing soil up to a depth of 12 to 18 inches. A backhoe (or similar shovel-based machine) may be utilized. An under drain can be included in the design to allow the soil to drain between storm events.

Figure 7: Installation of Soil Amendments